SMART RFID FOR LOCATION TRACKING

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Electrical and Computer Engineering
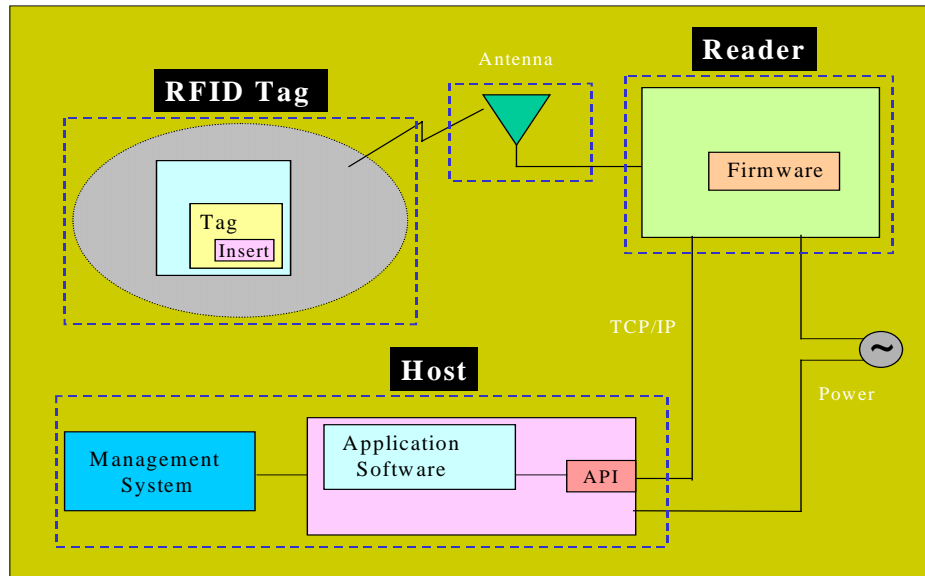
University of Windsor

Radio Frequency Identification (RFID)

- RFID is evolving as a major technology enabler for tracking goods and assets around the world.

- It promises to enable new efficiencies in the supply chain by tracking goods

- RFID has the potential to enhance many aspects of healthcare and patient safety.

RFID Components

Passive Tag

Active Tag

Tags: To store the information that describes the object being tracked.

Readers: To convert radio waves from RFID tags into digital data

Application Software: To manage the flow of data from readers

Location Tracking Technologies

GPS

- Currently used for outdoor navigation
- Line-of-sight requirements
- Uses Trilateration with location accuracy <15 meters in ideal conditions

Wi-Fi

- Signal range of 50-100 meters
- Many existing networks / access points already available
- Requires knowledge of AP location

Location Tracking Technologies

Bluetooth

- Limited read ranges (<50 meters)
- Cheap devices with limited bandwidth
- Channel hopping for communication can have large delays (2-10 seconds)

Radio Frequency Identification (RFID)

- No line-of-sight requirements
- Passive and active tags
- Good accuracy requires dense deployment of RFID readers

Location-Aware Applications

- Tracking and monitoring of assets/people

    – Real-time visibility to optimize operations and increase production throughput

    – Tracking personal in secured sites such as nuclear stations, underground mines

- Navigation and guide systems
- Emergency services
- Shopping assistance

Advantages of Wi_Fi Location Tracking

– Already Existing 802.11 Infrastructure

  • User's do not have to purchase any specialized hardware

– Research has demonstrated that Wi-Fi signals can be effective for indoor localization
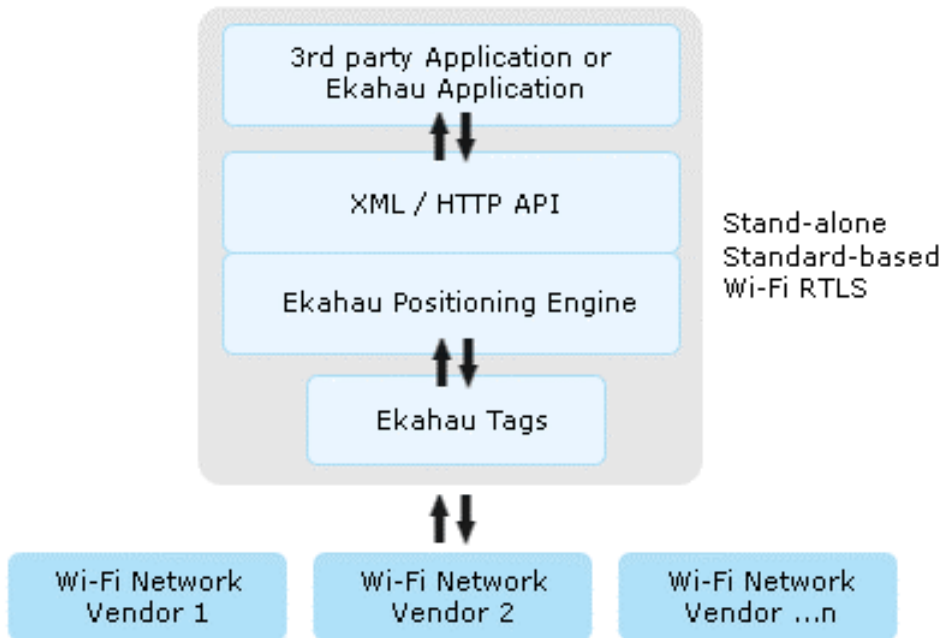
Typical access point < $100

Industry Players

Ekahau

Founded in 2000, Ekahau is the recognized leader in location-enabling enterprise Wi-Fi networks

Ekahau Wi_Fi Tags

Ekahau RTLS software to compute location of tracked objects

Industry Players

AeroScout:

AeroScout uses Wi-Fi-based active RFID, sensors, RTLS and other technologies to provide indoor wireless asset tracking and monitoring.
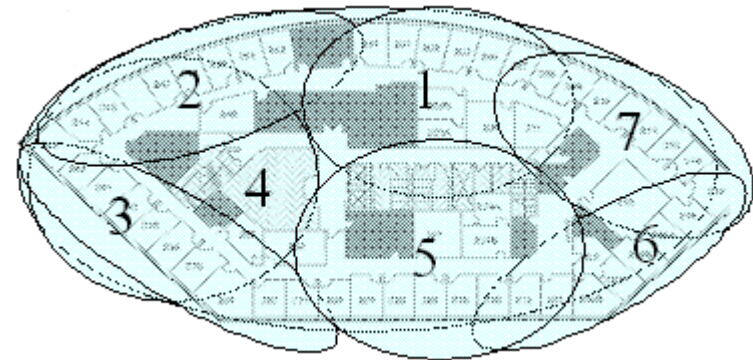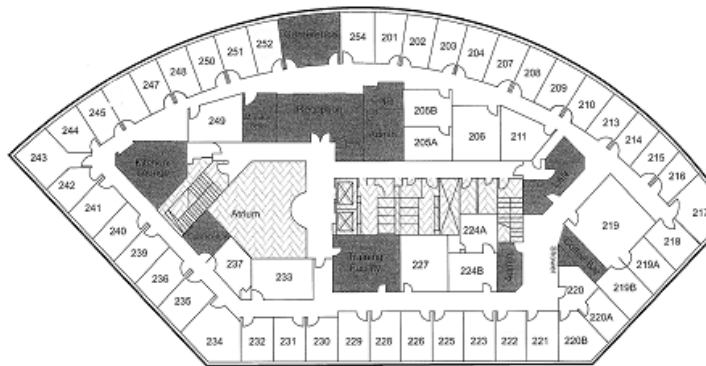
Investors: Intel, Cisco, …

AeroScout Wi_Fi Tags

# Localization with WiFi Network

100% floor coverage with 7 Wi-Fi Access points (standard 802.11b)

Localization with Wi_Fi Network

1. Proximity with location accuracy between 25 and 50 meters

2. Received Signal Strength Indicator (RSSI) Fingerprinting (Radio Map) with location accuracy depends on the number of access points.

SNR(1)=-85dbm
SNR(2)=-53dbm
SNR(3)=-31dbm
SNR(4)=-42dbm
SNR(5)=-55dbm
SNR(6)=-87dbm
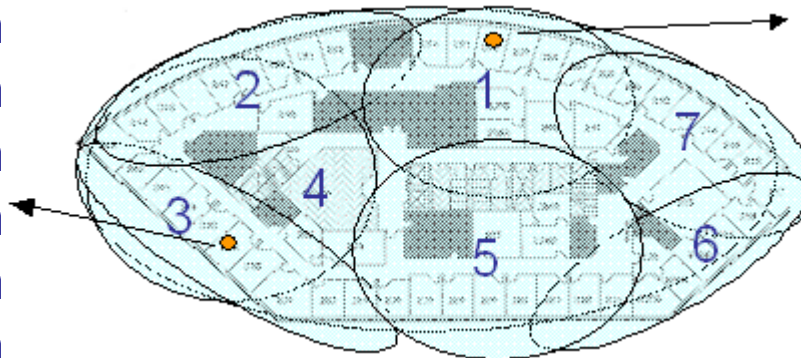
SNR(1)=-25dbm
SNR(2)=-43dbm
SNR(3)=-67dbm
SNR(4)=-48dbm
SNR(5)=-51dbm
SNR(6)=-71dbm

Drawbacks of Wi_Fi Location Tracking

– Received signal power is a function of environment factors (day, night, humidity, people,…)

– To generate a high resolution radio map, considerable numbers of fingerprinting have to be recorded. (updates are needed, time consuming process)

NetStumbler Scan Results

Network Stumbler - 20080711093232

File   Edit   View   Device   Window   Help

20080711093232

- Channels
- SSIDs
- Filters

| MAC	SSID	Name	Ch...	Speed	Vendor	Ty...
000B86CA84...	uwindsor		4	6 Mbps	Aruba	AP
001C101AAB...	wirelesslab		4	11 Mbps	(Fake)	AP
000B86CC8B...	uwindsor		4	6 Mbps	Aruba	AP
000B86CA93...	uwindsor		11	11 Mbps	Aruba	AP
000B86CC8E...	uwindsor		1	6 Mbps	Aruba	AP
000B86CCC5...	uwindsor		11	6 Mbps	Aruba	AP
000B86CC8C...	uwindsor		11	6 Mbps	Aruba	AP
0014BFAF9C...	FPGA Network		6	11 Mbps	(Fake)	AP
000B86CCA6...	uwindsor		4	6 Mbps	Aruba	AP
000B86CCA2...	uwindsor		11	6 Mbps	Aruba	AP
000B86CA88...	uwindsor		8	6 Mbps	Aruba	AP
000B86CCAA...	uwindsor		8	6 Mbps	Aruba	AP
001195FD7130	TSCGroup		6	11 Mbps	(Fake)	AP
000B86CCA3...	uwindsor		1	6 Mbps	Aruba	AP
000B86CC8F...	uwindsor		1	6 Mbps	Aruba	AP
000B86D4C4...	uwindsor		1	6 Mbps	Aruba	AP
000B86CC8A...	uwindsor		1	6 Mbps	Aruba	AP
000B86CCC5...	uwindsor		8	6 Mbps	Aruba	AP

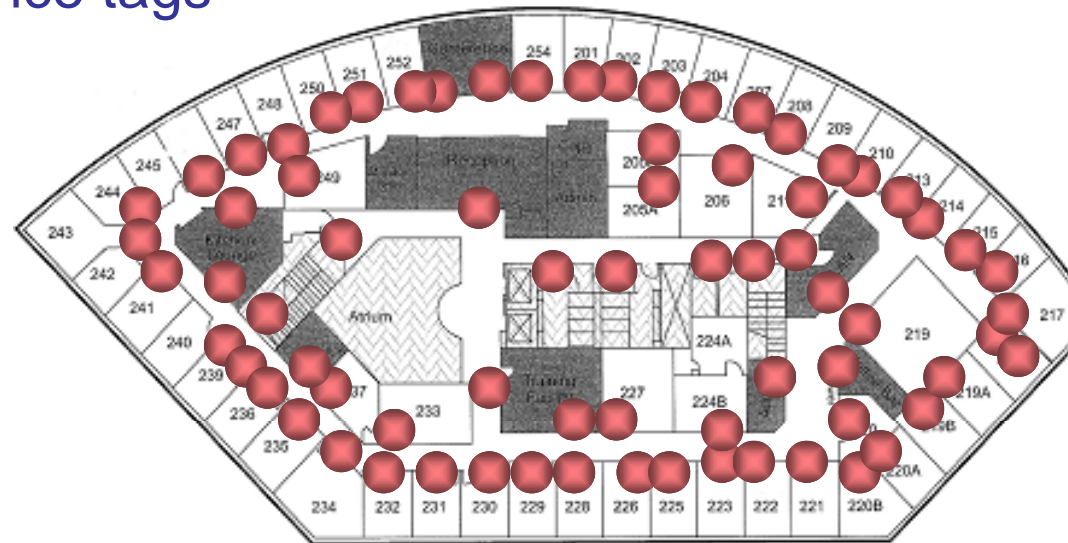Ready   No wireless adapter found   GPS: Disabled

Signal Strength by Netstumbler
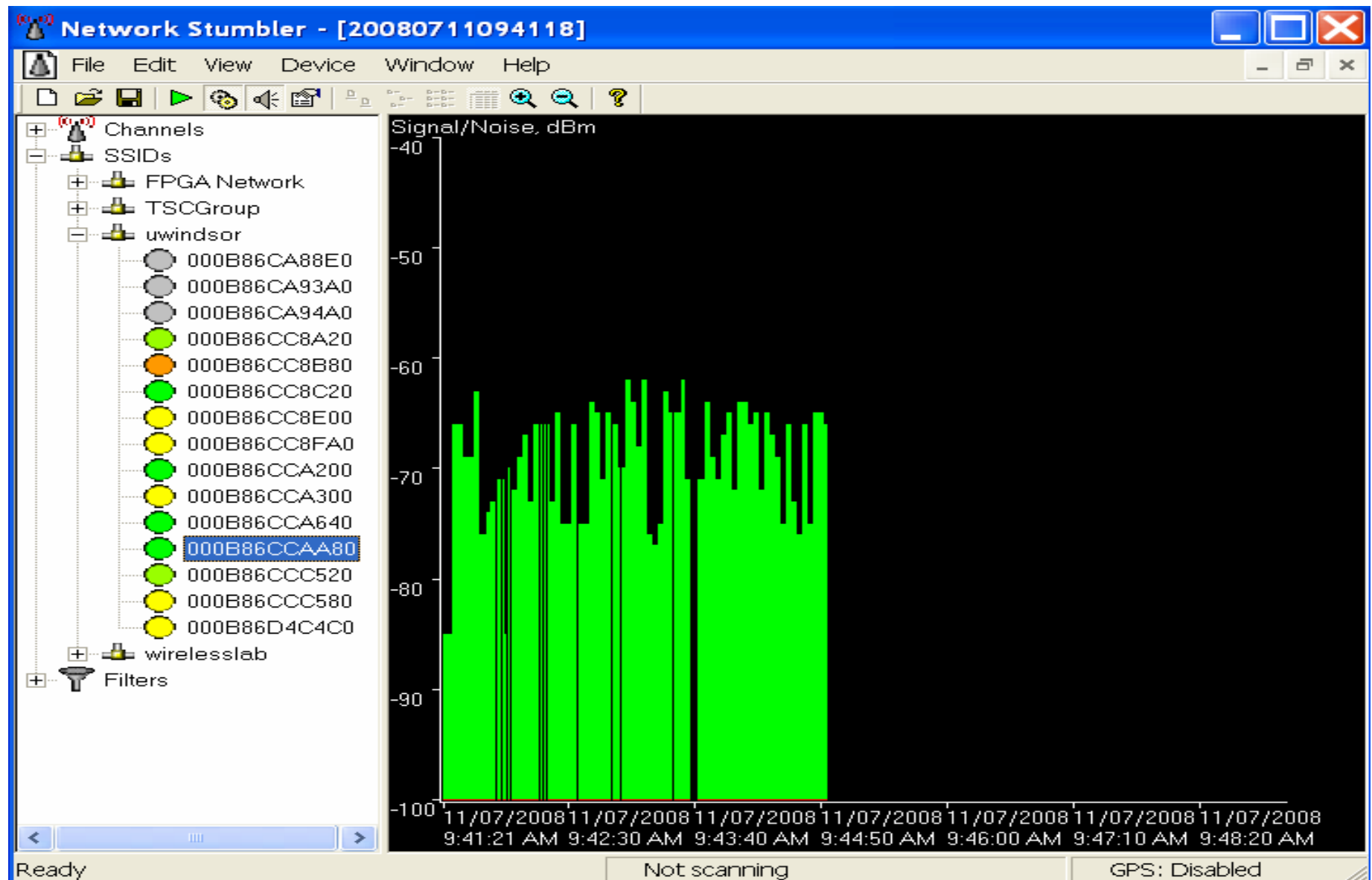
Drawbacks of Wi_Fi Location Tracking

- Wi_Fi signal strength fluctuation?

- No accurate radio map?

Solution: Reference tags

Problem: For high resolution considerable number of tags are needed (one tag per each square meter)

Proposed Solution

- The proposed method is based on a differential operation in which environmental factors are cancelled out.

- The mathematical models and simulation results indicates that the proposed solution can eliminates the effect of fluctuation in Wi_Fi signal strength problem.

- We may be able to even eliminate the need for radio map.

- The first objective is to protect the IP to permit publication and development of the prototype systems to prove the concept.

Results

➢ Received Signal Strength(RSS) of Wi_Fi access points can provide a good estimate for the location of the tracked object.

➢ The use of Wi_Fi network makes it possible to install a cost effective real time location tracking system.

➢ The fluctuation of Wi_Fi signal strength introduces a considerable error to object location estimation.

➢ The proposed differential RSS method has potential to increase the accuracy of the estimated object location.